Nano crystallized chalcogenide for photovoltaic applications

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Sb_2Se_3 is a non-toxic and earth abundant compound and has been extensively studied for a wide range of applications including solar energy conversion. This compound with an orthorhombic structure has an inherent anisotropic crystal structure promoting 1D nano-structure. It is the only stable phase in the Sb-Se binary system, which is different from the multi-valence Cu-Se and Sn-Se binary systems. It exhibits a direct band-gap of 1.1-1.3eV with a high absorption coefficient around 10^5cm-1. Theoretical calculations demonstrated that Sb_2Se_3 based solar cell is a promising candidate for achieving >30% efficiency, comparable to that of CIGS or CdTe.

In this work, Sb_2Se_3 based solar cells with heterojunction or homojunction will be prepared by using the sputtering technique. As-deposited thin films on substrates at room temperature are amorphous. Different heat treatments have been tested in order to get controlled crystallization of the thin films. It has been demonstrated that the crystal size and the crystal orientation are important for getting high performance photovoltaic solar cells.

Gradient Refractive INdex (GRIN) of chalcogenide glasses and glass-ceramics transparent in the infrared

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Gradient Refractive INdex (GRIN) lenses are optics whose refractive index varies spatially [1]. One advantage of such lenses is the possibility to manufacture lenses with simple shapes, such as flat lenses where the optical power is given by the continuous change of refractive index. In addition, this type of optics gives more freedom for the optical design. For example, the use of a specific index profile allows to correct efficiently thermal and chromatic aberrations with a significantly reduced number of lenses compared to a conventional system [2].

While these prospects appear to be quite attractive, and despite years of efforts [3], actually producing GRIN materials for infrared remains highly challenging. The presentation will shed some light on the strategies to obtain gradient refractive index in the chalcogenide glasses, which exhibit an extended transmission in the infrared range up to 16 µm [4]. First, the possibility to modify the refractive index within chalcogenide glassy matrix by optimized ion exchange will be described. Then we will also introduce a novel process for producing a radial GRIN in glasses by spatially controlled the formation of nanocrystals in the glassy matrix.